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ABSTRACT

Promoting ACademic Excellence in Mathematics and Science for Workers of the 21st Century (PACE) was a consortium project made up of Indiana University Northwest, the Gary Community Schools, and the Merrillville Community Schools. The focus of this project was to prepare teachers and curricula for Tech Prep mathematics and science courses for the two school districts. The courses and course units prepared by the project are intended to promote the Core 40 Competencies of the Indiana Department of Education for High School courses. This document contains units for biology designed to provide students with an overview of assorted biological fields such as genetics, classification, ecology, conservation, microbiology, and detailed plant and animal studies. The course advocates practical application, inquiry, exploration, and collaborative participation. Units are as follows: (1) Scientific Potpourri; (2) Microorganisms; (3) Cell Growth and Reproduction; (4) Plant Growth and Reproduction; (5) Genetics; (6) Nutrition; (7) Human Environmental Awareness; (8) Ecology; (9) Natural Resources; and (10) Water. (JRH)

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ED 461 481

Biology

an Applied Approach

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Editors

PACE **Promoting Academic Excellence In Mathematics, Science & Technology for Workers of the 21st Century.**

Gary Community School Corporation
Merrillville Community School Corporation
Indiana University Northwest

SE 060 336

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Biology
An Applied Approach

Introduction

This Biology course reflects the entire spectrum of all living things. This course is designed to provide students an overview of assorted biological fields such as genetics, classification, ecology, conservation, microbiology, and detailed plant and animal studies. Labs will be used to provide further experience and help reinforce the topics. Through the coverage of biological concepts, students should master the content of biology, experience the processes of biology, and evaluate the standards that guide the acceptance of biological knowledge claims.

This course should meet the needs of the students to fulfill their roles as informed citizens. It can be distinguished from other courses by the methods in which this course is being taught. The course will prepare students through practical application, inquiry, exploration, and collaborative participation.

The target group is the middle 50% who will benefit from a more technically oriented education. This program will accept students with a basic knowledge of science and math skills. The student should express an interest in/or anticipate employment in a technical field, but may also include those who would benefit from additional education in any post secondary program.

Upon completion of this course the students can meet the CORE 40 requirements for biological competencies and apply skills acquired through practical application, inquiry, exploration, and collaborative participation.

CONTRIBUTORS

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BIOLOGY UNITS

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PACE

Promoting ACademic Excellence in Mathematics and Science for Workers of the 21st Century

PACE was a consortium project of Indiana University Northwest, the Gary Community Schools, and the Merrillville Community Schools. It was supported by funds from the three institutions and by Eisenhower grants from the Indiana Higher Education Commission.

The focus of the project was to prepare teachers and curricula for Tech Prep mathematics and science courses for the two school districts. The effort took place over 1994 - 1996 and involved more than 70 teachers from seven High Schools. The Director of the project was Dr. Clyde A. Wiles, and the Associate Director, Dr. Kenneth J. Schoon, both of Indiana University Northwest.

Part of the effort was the developing of units and course outlines for use in the first two years of a High School Tech Prep program. Individual schools and faculty will be using these materials in a variety of ways from being a course guide to being a supplement to an already existing program.

We have taken the position that Tech Prep is not a program for the academically deficient. Rather it is an applied approach to curriculum that has the goal of promoting competencies recommended by the State of Indiana for non-remedial high school courses, and which does so in a learning environment that emphasizes applications. We would like students to find within these course materials and instructional approaches immediate and obvious responses to the questions: "What does this look like?" and, "Why would anyone want to know?"

These courses and course units then are intended to promote Core 40 Competencies of the Indiana Department of Education for High School courses. For mathematics, we viewed this as beginning with Algebra One and for science beginning with Biology. The Pre-Algebra course is not a Core 40 course, but does maintain the applied perspective.

Our efforts have had to accommodate to several factors. First there is an Indiana mandate that all high schools have a Tech Prep curriculum that targets the academic and school-to-work needs of the middle 50% of the high school student population. There are on the other hand, persistent beliefs of counselors, teachers, administrators, students, and parents that something called "tech" anything, is just another name for a program intended for "at risk" students who are not expected to acquire competencies at a level that would enable them to pursue post secondary schooling at the college or university level. These beliefs are often supported by admission policies at some universities. We have, therefore, attempted to position Tech Prep courses as courses that meet exactly the same Core 40 competencies (as defined by the Indiana Department of Education) as are to be met by college prep courses of the same name, but to do so in applications-based and problem-centered approaches.

Clyde Wiles, Director
Kenneth Schoon, Associate Director

Division of Education
Indiana University Northwest
Gary, Indiana
May, 1997

Unit 1

Scientific Potpourri

Unit 1: Scientific Potpourri Suggested time: 2 Weeks

Introduction

In this unit students will discover various careers in biology. Students will be introduced to the metric system, will find out how scientific measurements are made, and will learn what tools are used to make them. They will learn that there is another way to explain the world: that is to assume that all events in nature have natural causes. The most intriguing and important aspect of the unit will be learning the scientific method, which is the process scientists use to solve problems, and how this method applies to their everyday lives.

Unit Objectives

(Reference numbers refer to the Indiana Biology Competencies)

Students will

1. State the main goal of science. (Bio 1.1.1 and 2.2.2)
2. Describe various careers that depend on biology. (Bio 2.3.2)
3. List the tools of biology. (Bio 1.2.4)
4. Discuss the importance of a universal system of measurement. (Bio 1.2.2)
5. Identify and use the basic units of length, volume, mass and temperature in the metric system. (Bio 1.2.2)
6. State and describe the steps in the scientific method. (Bio 1.1.1)
7. Discuss ways in which scientific knowledge is constantly changing. (Bio 2.1.2 and 2.3.2)
8. Explain the relationship between science, society and technology. (Bio 2.2.1)

Learning Activities/Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

Initial Activities

1. To introduce this unit divide students into groups of four. Give each group a different type of problem (i.e. health, political, social, economical), or give each group the same problem. Allow students fifteen minutes to brainstorm solutions. Have them list the steps they took to solve their problem. Provide each group with the six steps to the scientific method, (these should be prepared beforehand on strips of paper). Have each group match their steps with the six steps to the scientific method, placing them into a sequence which the group perceives to be correct. Have students compare their sequence to two other groups' and discuss what conclusions they can draw concerning the use of their group's method. The teacher may list the steps of the scientific method on the board and have a class discussion. As a homework assignment, have the students use the steps to the scientific method to solve a problem at home.

2. Begin by asking the students,
   "Suppose you knew nothing about science. How would you explain what causes AIDS?"
   (Accept all answers including those that do not include scientific information.)
   "Suppose someone did not believe your explanation. Could you prove that it is right?"
   "Why or why not?"
   "How might you go about finding out if your explanation to this question is right?"

   The teacher should write the various responses on the board and discuss whether it is a misconception (i.e. catch by kissing, sneezing or causual contact) or whether their response has a basis for scientific fact. As reinforcement have students do one or all of the following:

- Call the 1-800 AIDS hot line for information.
- Contact the Center for Disease Control(CDC).
- Use the Internet to access information.
- Contact the local Health Department or an AIDS organization to invite a speaker to classroom.
- Research and report.

Other Activities

1. Students will perform mini lab, "Does Aspirin Help Plants Grow?" Their aunt tells them that plant cuttings will grow faster if aspirin is added to the water. Design and conduct an experiment to find out if this is true.

2. Inform the students that they have just been hired by the Department of Weights and Measures. Their responsibilities will be to: Measure ten items, weigh ten items, and get the volume of ten items according to the measurement system of the United States. Then provide students with a conversion chart and have convert their answers to metric units.

3. Students will work in groups for this assignment. They are biologists and have the opportunity to travel back in time to study an extinct species of their choice. The teacher will set up several lab stations containing various tools of biology. Each group will select one modern tool for its study. Students must devise a plan of study on how they will use the tools they selected to examine their species. The plan must include topic questions that the students want to answer, hypothetical measurements, possible resources, how they will show what they have learned when they have completed their group project.

4. Students are assigned to bring in one item from home that they feel was made possible through modern technology. Students will discuss how recent technology relates to the production of their particular item and what type of technology was used. Students will return to groups and discuss how our use of scientific technology has raised questions that do not have easy answers. Each group will select a topic research and report its position pro or con.

Unit 2

Microorganisms

Unit 2: Microorganisms — Suggested time: 4 weeks

Introduction

This unit will introduce the student to the microbial world and impress upon the student the important relationship between microorganisms and macroorganisms. It will provide the student with a general survey of microorganisms including their metabolism, growth, and death. Also included are the ecologic relationships and roles of microorganisms in natural or controlled environments such as soil, water, food, milk, and in industry, and the interactions of pathogenic microorganisms and their animal or plant host.

Unit Objectives

(Reference numbers refer to the Indiana Biology Competencies)

Students will:

1. Demonstrate how the maintenance of a relatively stable internal environment (e.g. temperature, chemical composition, pH) is required for the continuation of life. (Bio. 3.6.1)
2. Describe how stability is challenged by changing physical and chemical environmental conditions, as well as the presence of disease agents. (Bio. 3.6.2)
3. Develop skills in using common laboratory and field equipment and perform common laboratory techniques using microorganisms and macroscopic organisms. (Bio. 1.2.4, 1.2.5, 1.2.6, 1.2.7)
4. Recognize that all organisms consist, at some time in their life cycle, of a single cell. (Bio 3.4.1)
5. Describe the relationships microbes can have with other organisms: parasites, commensalism, mutualism, competition, active coexistence, predator/prey. (Bio 3.2.1, 2.2.1)

Workplace Relationships

1. Clinical Laboratory Microbiologist/Bacteriologist - receive specimens and identify the pathogen (the disease causing microorganism) or pathogens present in the specimens. Run tests to find out to which antibiotics the pathogen is sensitive. An undergraduate degree in microbiology is a requirement for this job.
2. Food services/Home Economics Teacher - Food service directors coordinate the daily operation of the kitchen, plans menus, orders food, and helps with meal preparation (bakers, cooks, wine testers, dairies); Home Economics teachers are responsible for teaching the basic four food groups. These teachers prepare students to become homemakers, cooks, and nutritionists.
3. Environmental Quality Technician - This job includes drawing samples from water and testing the samples in the laboratory to see what pollutants they contain. They assist the laboratory chemist who checks for certain bacteria and various pollutants. Technicians are also responsible for reading meters and gauges and keeping records of their readings. They must know how to use pH meters, spectrophotometers, analytical instrumentation, and general chemical laboratory equipment. An associate's degree in environmental technology and knowledge of biology and chemistry is essential for an environmental quality technician.
4. Wine Tester- tests for wine spoilage microorganisms and makes a report to the wine company. A food science degree with an emphasis on oenology (the science of wine making).
5. Waste Treatment Specialist - conducts lab tests; reports on quality to the federal Environmental Protection Agency (EPA); takes samples of effluent (water that is going out of the plant after treatment); runs test to find out what suspended solid matter is in water; monitors the growth of microscopic organisms.
6. Other jobs include a dermatologist (skin and microorganisms), soil conservation technician (agriculture, forestry), infection control specialist (hospital).

Learning Activities / Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

Initial Activities

1. To introduce this unit allow students to view selected sections from the movie *Outbreak*. Go around the room and have each student make a statement about viruses in the movie. Write the statements on the chalkboard. Be certain that information is included that describes the basic structure, the genetic makeup, the reproductive cycle, host carrier, and the disease caused by viruses. Then divide the students into groups of 3-4. Have them investigate an outbreak of "Pathogens in the School." Assign each group one of the following school area locations: cafeteria, snack machine area, restroom, locker room, shower area, pool area, drinking fountain, etc.. Have students, working in groups, create a plan and make a drawing that will portray how a contagious disease might spread among students using the area. The plans must include topic questions that the students want to answer, possible resources, possible preventive techniques, how they will show what they've learned when their investigation is complete.
2. Break the class into groups of four. Give each group four petri dishes and detailed instructions explaining the procedure for using petri dishes. Include a discussion on the differences between sterile and antiseptic. In each asigned school location, have students place a palm print on the first dish; slide the palm of a hand along a surface in their assigned area; place a palm print on the second dish; wash their hands with water and then imprint the third dish; then wash with disinfectant and imprint the fourth. Have students incubate the petri dishes for 24 hours and observe the growth of microbes on each plate. Students should draw diagrams of each dish. Students should examine each dish and discuss what conclusion they can draw about the different techniques used. Have them compare their dishes to those of other groups and discuss what conclusions they can draw concerning the use of disinfectant. Record class data and discuss the findings. If possible contact a microbiologist, public health expert or other knowledgeable person to find out the effectiveness of microbial population control methods.

Other Activities

1. Break students into groups of four. Give each group a lab procedure for using a bacterial culture to make yogurt by following any generic yogurt recipe. Allow students to perform the lab. Students should record and discuss results. Then lead students into a discussion of why this process works. Teachers should review the topic of lactic acid fermentation after completing this activity.
2. Plan a field trip to a waste water treatment plant to observe the three main steps in processing waste water including a biological process involving microorganisms.
3. Create a bacterial cell model. Divide students into groups of four and provide each group with two 1-liter plastic drink bottles cut 10 cm from the bottom, rubber bands (to represent plasmids) and colored mop ribbons (to represent DNA). Decide if you want to tell students that the cell wall is the colored plastic bottom and the clear part represents the cell membrane. Instruct students to build a bacterial cell model.
4. Have students test the effectiveness of various disinfectants such as ethanol, alcohol, isopropanol, bleach, and Lysol. Give students cotton swabs to inoculate prepared agar plates of specific areas before disinfecting. Have them clean the same area with a specific disinfectant, using a sterile cotton swab to inoculate a different plate, and incubate both plates at 25 degrees Celsius for 48 hours. Compare microbial growth on the two plates to see which has fewer colonies, thus showing the best disinfectant. Students also may learn to count bacterial colonies on a culture plate. As a math component, the students can use various dilutions of the disinfectant, and record ratios.

5. Have students follow a basic gram staining procedure to identify bacteria as Gram positive or Gram negative. Staining agents are saffron and crystal violet. Students will discuss the factors that make them either one or the other.
6. Break class into groups of four. Give each group a lab procedure to follow that will allow the students to observe the effects microbes have on the rate of decomposition of various materials. Use 2-liter plastic drink bottles cut off near the top. Using three different bottles, students will use three different types of soil (top soil, sterilized soil, and compost) to bury organic wastes such as a fruit core, vegetable shreds, or paper. Making two layers, moisten as needed over 4 weeks and take temperature readings daily. Students will record readings, and uncover once each week to make observations as to rate of decomposition, etc. Wet and dry compost will be used to demonstrate environmental conditions.
7. Assign students to do research and report to the class on a specific disease caused by a virus or bacteria, noting method of transmission, cure, symptoms, and other pertinent factors.
8. Break students into groups of four. Assign each group six different canned good items. Instruct each group to use pH paper to test foods preserved by canning and by using large acidity factors. Students will record and report their findings to the class.
9. Students will view prepared slides of microorganisms in the 4 main groups. They can list differences such as shape, size, color, etc.

Evaluation

25%: Evaluations will be completed using a checklist of student performance in group activity and productivity.

15%: Assessment of individual student portfolios. Students will keep a "file" of their work, which will be turned in for teacher's assessment at the end of the unit.

50%: Standard Friday quizzes and tests, with immediate feedback, will reinforce the applications taught.

10%: Student behavior, attendance, class participation, and assigned homework tasks will be evaluated to determine whether student has achieved required learning objectives.

Resources

1. *Applications in Biology/Chemistry: A Contextural Approach to Laboratory Science.* Microogranisms unit resource materials. Waco, Texas: Center for Occupational Research and Development, 1992.
2. Carpenter, Philip L. *Microbiology.* Philadelphia: W. B. Saunders Co., 1967.
3. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, Indiana, 1995.

Unit 3

Cell Growth and Reproduction

Unit 3: Cell Growth and Reproduction Suggested Time: 3 Weeks

Introduction

This unit is designed to explain how a cell is organized and how it functions. It will cover the development of the cell theory, the particulars of cell structure and will distinguish between prokaryotic and eukaryotic cells.

Unit Objectives

(Reference numbers refer to the Indiana Biology Competencies)

Students will:

1. Develop skills in using common laboratory and field equipment and perform common laboratory techniques with care and safety. (Bio 1.2.4.)
2. Recognize that all organisms consist at some time in their life cycles, of a single cell. (Bio 3.4.1)
3. Understand that organisms may reproduce sexually and/or asexually.(Bio 3.4.2.)
4. Describe how all growth and development is a consequence of an increase in cell number, cell size, and /or cell products, as well as cellular differentiation.(Bio 3.4.3.)
5. Define the relationship between activation energy and a catalyst.

Workplace Relationships

1. Crime Lab Technician-gathers and evaluates various lines of evidence from a criminal investigation.
2. Toxicologist-tests to determine the safety of the workplace.
3. Pathologist or Medical Technician-examines cells and tissues for abnormal growth (cancer).
4. Patient Care Technician-weighs, checks temperature and blood of incoming patients.
5. Physician - diagnoses and treats patients and prepares medications.
6. Emergency Medical Technician - is a highly skilled medical worker who is trained to carry out some of the more routine duties of a physician, such as first aid and other life support services.
7. Physician Assistant - graduates of intensive 2-year program approved by the American Medical Association. They are skilled in taking case histories, giving medical examinations, making diagnoses, and providing basic medical care.
8. Wine Tester - has a food science degree and has the responsibility of testing the wine to make sure it does not contain microbes that will eventually cause spoilage.

Learning Activities / Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

Initial Activities

1. Break the class into groups of four. Give students prepared thin slices of cork to view through a microscope. Ask students to describe what they see. Then ask: "If you were a scientist seeing this sample for the first time, what further questions would you want to investigate?" Allow time for group discussion to come up with two or three questions, then share group questions with class. Then list the three postulates of the cell theory on the chalkboard.

   Provide the students with appropriate reading from the text and any resource materials covering the historical development of each postulate. Now assign each group member one of the following tasks: Create a time line that chronicles the development of the cell theory; draw and label a diagram of a prokaryotic cell and a eukaryotic cell; make a chart that shows the differences and similarities of a prokaryotic cell and a eukaryotic cell; draw a diagram that

shows the relationship between surface area and volume of a cell. Have students present their materials to one another and copy significant information into their notes.

2. Using slides, transparencies, or photographs, show a wide variety of cells. (Do not offer an introduction or explanation.) Ask the students to identify what they think they saw. Then ask them what all of the pictures had in common and how they differed. Allow time for group discussion. Introduce appropriate terms include the difference between eukaryotic type and prokaryotic type. It is important that students know that they have observed cells and should be able to note differences such as relative degree of complexity, size, color, and number of cells.

Other Activities

1. Have students look at pictures or slides either on a viewer or microscope to get an idea of what cells look like. Have them identify the nucleus, the cytoplasm, and the chromosomes. Have them sketch a basic outline of the cells they see. Have them compare normal with abnormal cells. Ask them how they can identify the abnormal cells.
2. Using construction paper, have students make models of cells labeling the organelles and use the models to make a bulletin board. Have them decide on a theme or title for the bulletin board. One suggestion may be, "Cells: The Structural Basis Of Life."
3. Break the class into groups of four. Set up hypothetical situations involving a murder case, rape trail, and paternity suit in which the students become the Crime Lab Technicians. Assign each group an investigation. Set up seven different lab stations with evidence pertaining to each of the situations to be investigated. Become creative- evidence should include possible murder weapon, blood types, DNA fingerprint, simulated gel electrophoresis samples, diagrams or pictures, material evidence specimens, case histories, etc. Groups should be reponsible for writing a plan to solve their case. The plans must include topic questions that the students want to answer, possible resources, and what they have concluded, when they've completed their group investigation.
4. Break the students into groups of four. Give each group a set instructions for making a paper DNA fingerprint. Provide each group member with the following material: scissors, simulated diagram of a gel electrophoresis plate with the number of nucleotides (markers) labeled from 1-23, grouped as 24-30, 31-35,36-40,41-50, and sheet of with a hypothetical strand of DNA labeled with the bases adenine (A), guanine (G), cytosine (C), and thymine (T). Now have students construct a strand of hypothetical DNA using the four different bases. Place 50 bases in random order along the colored DNA strand. Have them mark locations along the strand where they find an A/G combination. A restriction endonuclease identifies a specific base sequence in much the same way. With their restriction endonuclease (scissors), have them cut their DNA at each location that was marked. Count the number of bases in each segment and cut out a corresponding fluorescent band. Place each band on the gel at their respective locations. This simulates the running of a gel electrophoresis. Once they have completed these steps, have students compare their DNA fingerprint to that of their group members and others in the room. It is unlikely that any two DNA fingerprints are identical. Now lead the students in a discussion by asking the students to imagine a DNA fingerprint that is performed on millions of bases instead of just 50! Bring in appropriate speakers to provide reinforcement and to eliminate any misconceptions.

Suggested sequence for Learning/Laboratory Activities

from CORD, *Continuity of Life*

1. View the video "DNA Fingerprinting". Show transparency master for Subunit 1 and discuss the "Think About It" section on p. 2. Have students do *Real Life Situation #1.* (1 class period)
2. Read "Overview of the Cell", pages 4 to 5 and discuss. Have students do *Real Life Situation #2* . (2 class periods)
3. Read the introduction to the lab, "Why are Membranes Important to Cells?", on pages 25 and 26. Do parts I, II, and III, pages 27 through 33. (3 class periods)
4. Read the introduction to the lab, "How Can DNA Be Obtained From Cells?", on pages 34 and 35. Do parts I and II, pages 36 through 42. (3 class periods)
5. Read pages 6 through 10. Have students construct models of DNA using construction paper. Use different colors for each part of the DNA molecule. The students should use templates with complimentary shapes so that the bases will fit together. The students should answer the questions in Activity 1-2, page 10. (2 class periods)
6. Have students do Activity 1-3, page 11. Discuss the outcome. Read "How DNA Controls The Workings Of The Cell", pages 11 through 16. Students should do Activity 1-4, pages 13 and 14. Do Activity 1-5, p. 16. Students will demonstrate how DNA controls the production of proteins using the models they made. (3 class periods)
7. Read "How Do Cells Make More Cells?", pages 16 through 19. Do Activities 1-6, page 18 and 1-7, page 19. (1 class period).

Assessment

Lesson 1. Cell Survey and Comparison: See Appendix 1.
Lesson 2. Cell Model Construction: See Appendix 2.
Lesson 3. The answers to the Conclusion and Challenge Question and Extension sections are located on pages TN-32 and 33.
Lesson 4. The answers to the Conclusion and Challenge Question and Extension sections are located on page TN-42 and 43.
Lesson 5. The DNA models should include a series of representative alternating phosphate and deoxyribose molecules forming the sides of a ladder with the complimentary bases, A-T and G-C, forming the rungs of the ladder.
Lesson 6. Students should recognize that the majority of the base triplets are the same and that only several differ.
Lesson 7. Constructing A Model Of Mitosis: See Appendix 3.

Have students write answers to the following upon completion of the indicated Learning Activity.

1. Draw a model showing how cells are organized. Label each part of the cell. Describe the function of each part of the cell.
   (ans.) Example of cell found in Figure 1-1, page 4. The functions of the cell parts are found in Table 1-1, page 5.
2. Identify three court cases in the past five years where DNA evidence was used to convict an accused suspect or vindicate a convicted prisoner. Write a brief summary of each case and explain how the differences or similarities in DNA patterns was a factor.

Lesson sequence:

Week 1. Read "Overview of the Cell."
Participate in class discussions and activities.
Determine differences between different cell types.
Using a cell model, identify organelles and their functions.

Week 2. Lab: Why are membranes important to cells?
Using models of DNA and RNA, indicate replication, transcription, translation, and the sequencing of amino acids at the ribosome.
Video: *DNA fingerprinting*

Week 3. Concept mapping
Read: How DNA controls the working of the cell.
Lab: How Can DNA be obtained from cells?

Week 4. Using prepared sides identify phases of mitosis.

Evaluation

20% Evaluations will be completed using a checklist of student performance in group activity and productivity.

15% Assessment of individual student portfolios. Students will keep a "file" of their work, which will be turned in for teacher's assessment at the end of the unit.

50% Standard Friday quizzes and tests, with immediate feedback, will reinforce the applications taught.

15% Student behavior, attendance, class participation, and assigned homework tasks will be evaluated to determine whether student has achieved required learning objectives.

Resources

1. *Applications in Biology/Chemistry: a Contextural Approach to Laboratory Science. Continuity of Life* Teachers Guide. Waco, Texas: Center for Occupational Research and Development, 1993.
2. Schraer, William D. and Herbert J. Stoltze. *Biology, the Study of Life.* Englewood Cliffs, New Jersey: Prentice-Hall, 1995.
3. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, Indiana, 1995.

REAL LIFE SITUATION #1
CELL SURVEY AND COMPARISON

GROUP NAME AND NUMBER_____

Directions. After viewing the normal and abnormal cells, make drawings of each and answer #3 at the bottom of the sheet.

Normal Cell	Abnormal Cell

How can you identify the abnormal cells?_____

_____

_____

_____

Evaluation

	Well Done	OK	Poor	Not Done
Drawing of normal cell.				
Drawing of abnormal cell.				

Well Done = 3 Pts., OK = 2 Pts., Poor = 1 Pt., Not Done = 0 Pts.

SCORE: _____ (SCALE : 9-10 = A, 7-8 = B, 5-6 = C, 3-4 = D).

REAL LIFE SITUATION #2
CONSTRUCTING A CELL MODEL

GROUP NAME AND NUMBER_____

	Well Done	OK	Poor	Not Done
1. Did you construct examples of all the organelles from Table 1-1, page 5?				
2. Did you label all the organelles?				
3. Is your model neat and accurate enough to be included on the bulletin board?				

WELL = 3 Pts., OK = 2 Pts., POOR = 1 Pt., NOT DONE = 0 Pts.

SCORE: _____ (SCALE: 8-9 - A, 6-7 = B, 5 = C, 3-4 = D)

CONSTRUCTING A MODEL OF MITOSIS

GROUP NAME AND NUMBER_____

Directions. Follow the steps in Activity 1-6, page 18, to construct the stages of mitosis. Be prepared to demonstrate to your teacher. Answer questions 1 and 2. Carry out the remaining step.

	Well Done	OK	Poor	Not Done
1. Forming the chromosomes.				
2. Forming the nucleus.				
3. Demonstrating the following:				
Prophase				
Metaphase				
Anaphase				
Telophase				
Daughter Cells				

Well Done = 3 pts, OK = 2 pts, Poor = 1 pt., Not done = 0 pts.

Answer questions 1 and 2 below. (2 Pts. each)

_____

_____

_____

_____

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SCORE: _____ (SCALE: 23-25 = A, 18-22 = B, 13-17 = C, 8-12 = D).

Unit 4

Plant Growth and Reproduction

Unit 4: Plant Growth and Reproduction Suggested time: 4 weeks

Introduction

Two basic characteristics of organisms are growth and reproduction. In Plants, these basic processes take place in its tissue, which are comprised of the basic units of all living things - cells. Cell division gives rise to new cells, tissues, organs, and organisms - hence reproduction. Various types of plant tissues are specialized and carry out the important functions producing bark or fruit, transporting sugar and absorbing water from the soil. Together these different types of tissues make up plant parts called organs - roots, stems, leaves, and flowers. Students will become knowledgeable of how plants grow and reproduce by participating in the laboratory investigations and activities of this unit.

Unit Objectives:

(Reference numbers refer to the Indiana Biology Competencies)

Students will:

1. Develop skills in using common laboratory and field equipment and perform laboratory techniques with care and safety. (Bio 1.2.4)
2. Select and use reference materials to obtain relevant information. (Bio 1.2.5)
3. Organize and present data in the form of functional relationships. (Bio 1.3.1)
4. Formulate explanations to accommodate known phenomena and principles. (Bio 1.5.3)
5. Explore careers that require or involve science. (Bio 2.3.1)

Workplace Relationships

1. Urban Forester: provides people with information about the care, maintenance and purposes of trees.
2. Florist: works around and with flowers arranging them to bring joy to people.
3. Horticulturist: applies a scientific knowledge of plant life to the practical problems of growing and caring for plants.
4. Soil Analyst: tests samples of soil to determine its chemistry for use.
5. Seed Analyst: tests seeds that are for sale for purity, viability, moisture content and stress tolerance.

Learning Activities/Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

One: Activity 1.1. "Root Power." Students will plant four seeds, such as bean, pea or corn in a petri dish with cotton and distilled water or in zip-locked bags with moist paper and pin to bulletin board. Place seeds near edges of the plate, rotating each seed 90 degrees from the orientation of each other. (If using bags, place seeds on damped towel having them visible.)

Observe the growth everyday for a week and sketch the orientation of the roots and shoots.

A. Initiate a discussion with reference to placement and to the orientation of roots and shoots.
B. What conditions affect seed germination? Note: In this learning activity, students use one of two methods to do germination tests on selected seed samples using petri dishes as germination chambers.

The two methods are: 1) testing seeds by treating them in three ways to determine germination requirements; 2) testing seeds by placing them in three different types of soil to determine germination requirements. Discuss root function and our use of roots moist or dry.

Two: Set up a display with various types of trees. Allow students to examine the trees and ask students to describe what they see, concerning color, texture, and whether the tree looks healthy or not. Then ask, "If you were a Urban Forester seeing these samples for the first time, what further questions would you want to investigate?" Allow students to work in groups of four, and allow time for group discussion.

Three: Bring in an Urban Forester as a speaker. Allow a question and answer period for students. As a homework assignment, have students read, "Stem Strength and Stem Function," pp. 11-15 or use appropriate text information.

Four: Lab 1: "Stem Race: Effect of the Hormone Gibberellin On Plant Growth." Note: In this activity, students will compare the growth of shoot tips on seedlings to which they have applied deionized water and gibberellin solution. After observing and taking data for one week, the students should calculate the average length for both plant seedlings. The data should be plotted on a graph showing changes in shoot length from day to day.

Five: Field trip to Deep River Outdoor Education Center. Students walk through the trails and identify different types of trees and bud location on stems. Allow students time to sketch trees, buds and stems.

Six: Lab 2: "How Do Nutrients in the Soil Become Available to Plants?" Note: This learning activity will be done in two parts. Part 1: Students are to examine the solubility of ions extracted from water, acids, and bases under pH conditions. Part II: Students are to examine the solubility of salts under different pH conditions to determine the solubility of specific ions at high and low pH values.

Seven: Lab 3: "How is Seed for Sale Tested and Labeled?" Students will test seeds for purity and viability and prepare an accurate label for a bag of seeds. A calculation of percentage of inert matter, foreign crop seeds, weed seeds, and noxious seeds for a seed sample will be carried by the students.

Eight: Lab 4: Plant Cell Study Kit. Students will stain cross sections and macerated stem tissue. They will use the diagrams and dichotomous key for identification of various cell types.

Nine: Activity 2: (Optional) Conventional Method of Vegetative Propagation. Note: Students will grow new plants using several techniques, including stem and leaf cutting.

Ten: Research: Students should research the latest genetic engineering used in plant growth and reproduction and apply it to one of the workplace relationships. Have students present to class. This can be used as a library class assignment.

Evaluation

20%: Performance in group participation and productivity.
25%: Assessment of individual student portfolios.
35%: Quizzes and tests
20%: Attendance, behavior, class participation, and homework.

Resources

1. *Applications in Biology/Chemistry. a Contextural Approach to Laboratory Science. Plant Growth and Reproduction.* Waco, Texas: Center for Occupational Research and Development, 1994, c 1992.
2. McLaren, James E., Lissa Rotundo, and Laine Gurley-Dilger. *Heath Biology.* Lexington, Massachusetts: D. C. Heath, 1991.
3. *Plant Cell Study Kit,* Lab-Aids, Inc., Cat # 61.
4. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, Indiana, 1995.

Unit 5

Genetics

Unit 5: Genetics — Suggested time: 4 weeks

Introduction

This unit is intended to provide students with knowledge of heredity, the transmission of traits from parents to their offspring. Students will discover that for hundreds of years, people were puzzled by the patterns of heredity, and only in this century have scientists begun to understand the molecular basis of heredity. However, the roots of the discovery of heredity can be traced to the experimentation of Gregor Mendel.

Unit Objectives

(Reference numbers refer to the Indiana Biology Competencies)

Students will:

1. Explain how the material, informational, and mechanistic basis of inheritance is shared by all living things. (Bio 1.1.1, 3.3.1)
2. Understand the processes by which genetic information acts, changes, and is propagated from generation to generation. (Bio 3.3.2)
3. Describe how the action of genes, patterns of inheritance , and the reproduction of cells and organisms account for the continuity of life. (Bio 1.2.1, 2.1.3)
4. Explain how Mendel discovered the laws of heredity using the information available. (Bio 1.1.1, 2.1.3, 2.3.2)

Workplace Relationships

1. Emergency Medical Technician - is a highly skilled medical worker who is trained to carry out some duties of a physician in an emergency situation.
2. Physician (all specialties)- diagnoses and treats patients and prepares medications.
3. Nurse Practitioner - is a highly skilled medical worker who is trained to carry out some duties of a physician.
4. Genetic Counselors - discusses inherited disorders that reflect gene mutations or abnormalities in chromosome structure or number and result in functional or anatomical changes.
5. Family-Planning Specialist - provides information and counseling to clients, especially teen-agers, on birth-control and pregnancy options, and other issues related to reproductive health.
6. Genetic Engineering - is the application of the knowledge obtained from genetic investigations to the solutions of such problems as infertility, diseases, food production, waste disposal, and improvement of a species.
7. Technical Education - prepares individuals for entry into those occupations that lie between the skilled crafts and the engineering and scientific professions.

Learning Activities/Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

WEEK ONE

Day One: Introduce the Chapter on Genetics. Students will write a journal entry explaining how Mendel discovered the laws of heredity using the information available to him. Students will read their journal entry to their classmates and share what they have expressed in their journals.

Day Two: Students will outline the garden pea experiment of Gregor Mendel. Step 1), Parental Generation, Step 2), F1 Generation, Step 3), F2 Generation. Students will define the following terms associated with the outline: heterozygous, homozygous, dominant, recessive, geneotype, phenotype, and alleles.

Day Three: Students will play a game called, "On the Fence." Students will be divided into three groups. One side that agrees, one side that disagrees, and one side that is undecided. Students can move anytime that they change their minds during the discussion. Students will be comparing and

contrasting each of Mendel's laws of heredity. Example: How does the law of segregation differ from the law of independent assortment?

Day Four: Students will show how Punnett Squares help us understand the results of crosses between pea plants or other organisms. To make it more interesting have students do a monohybrid cross for sickle cell anemia. Students will provide ratios using the Punnett Squares.

Day Five: Students will write a journal entry explaining the relationship between genes and chromosomes. Students will share their entry with classmates by reading to the class.

WEEK TWO

Day Six: Students will draw a diagram summarizing events that occur during meiosis.

Day Seven: Students will be asked to define cross over in their journals and explain its role in evolution. If time permits they will share their journals with classmates.

Day Eight: Students will view a video and see how sex chromosomes determine the sex of humans. A class discussion will follow this video.

Day Nine: Students will view a video that recognizes the relationship between mutation and human genetic disorders.

Day Ten: A physician will visit and show slides pursuant to a class discussion on how the sperm and the egg determine the sex of a child.

WEEK THREE

Day Eleven: Invite a genetic counselor to discuss his/her work.

Day Twelve: Take a trip to the hospital where staff will explain the patterns of inheritance in cystic fibrosis and sickle cell anemia. They will also explain where the instructions for specific traits are located in cells.

Day Thirteen: Students will describe in their journals some of the benefits that gene technology might offer. Students will read their journal entries to the class.

Day Fourteen: Have each student trace his/her family tree to see the inheritance of any genetic disorders. We will discuss how a pedigree is used to trace the inheritance of a genetic disorder?

Day Fifteen: Show a video about gene technology; discuss how gene technology could be used to cure a genetic disorder.

WEEK FOUR

Day Sixteen: Students will review for the test by playing "Family Feud." The game will include vocabulary, questions, completion, true and false, and essay.

Day Seventeen: Students will take a chapter test on heredity, chromosomes, and human genetic disorders. The test will consist of vocabulary, questions, completion, true and false, and essay.

Evaluation

20%: Performance in productivity, group and lab participation.
25%: Assessment of individual student portfolios.
35%: Quizzes and tests.
20%: Attendance, behavior, class participation, and homework.

Resources

1. *Applications in Biology/Chemistry*: Teacher's Guide. Waco, Texas: Center for Occupational Research and Development, 1993.
2. Kaskel, C. E., *Laboratory Biology: Investigating Living Systems,* Columbus, Ohio: Merrill, 1979.
3. *Applications in Biology/Chemistry*: *a Contextural Approach to Laboratory Science. Continuity of Life.* Waco, Texas: Center for Occupational Research and Development, 1993.
4. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, Indiana, 1995.

Unit 6

Nutrition

Unit 6: Nutrition — Suggested Time: 4 Weeks

Introduction

This unit is designed to prepare students for actual life experiences pertaining to food and nutrition. This unit will cover how different diets affect different needs, how human dietary needs change during the life cycle, how animal dietary needs change during the life cycle, and how diets affect special human populations using practical applications, inquiry, exploration, and collaborative participation.

Unit Objectives

Students will:

1. List some important vitamins and minerals in the diet and identify their function.
2. Explain what is meant by a balanced diet and why such a diet is important.
3. Discuss diseases that result from nutrient deficiencies.
4. Discuss the effects of the eating disorders anorexia nervosa and bulimia.
5. List the nutrients required to maintain good health.
6. List two ways the body uses lipids, proteins, carbohydrates, water, vitamins, and minerals.
7. Review diet plans to determine the balance of your caloric intake and average caloric usage, and forecast the effect that such a diet may have on your body weight.
8. Select different diets used in various health conditions including age, pregnancy and disease states.
9. Correlate the digestive system, endocrine system, anatomy, and physiology in humans and animals to their food or feed requirements.
10. Explain how the process of hemodialysis works.
11. Explain how the kidneys help maintain homeostatis.
12. Explain how nephrons are specialized for urine formation.
    During filtration, water, glucose, amino acids, and urea move out of the capillary and into the nephron. During reabsorption, water, glucose, amino acids, and many salts move out of the nephron and back into the bloodstream.
    Some kidney disorders can be managed with hemodialysis, a process that uses a semipermeable membrane to simulate the filtering action of the kidney.
13. Explain which substances nephrons filter out of the blood, and which are reabsorbed.
14. How do digestive enzymes work?

Workplace Relationships

1. Food Technologists - requires a bachelor's degree in food technology and nutrition. A food technologist works for food manufacturers, government agencies, in research and development departments of colleges and universities, in quality control laboratories, test kitchens, or processing plants.
2. Food Service Directors - coordinate the daily operation of the school kitchen, do all the menu planning for the month ahead, order food for the next week from a visiting wholesale representative, and help prepare the breakfast and lunch meals for students and teachers.
3. Dietetic Technicians - manage food service department, and work under the supervision of a registered dietitian. They assist with the development of special menus for individual patients according to their physicians' orders.
4. Head Cook - has a great deal of responsibility for the food preparation for the restaurant, and are generally more skilled, experienced, and trained than other cooks. A head cook or chef requires training from a vocational high school and/or apprenticeship program. Many learn cooking in

hotels, restaurants, or in the military.

5. Zoo Keeper - is responsible for cleaning animal enclosures, and feeding the animals. A zoo keeper watches animals under his care for behavior changes, signs of illness, or times for breeding. He or she must have excellent writing skills in order to accurately record animal behavior. Must have a high school diploma, and take a biology course.
6. Home Economics Teacher - is responsible for teaching the basic four food groups, and instructing students how to prepare healthy well balanced meal from the basic food groups. This teacher prepares students to become homemakers, cooks, and nutritionist.
7. Diet Counselor - counsels individuals who need to lose weight through a structured program that is medically approved. A diet counselor also, teaches nutrition, signs up new clients, explain the weight-loss program, records progress daily, and of weekly weigh-ins.
8. Nutritional Consultant - treats eating disorders and is assisted by a psychologist, a psychiatrist, a physician, and a nutritionist.

Learning Activities / Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

Problem-Solving Activities

Divide the class into teams. Give each group a problem for which to brainstorm solutions.

1. Taylor is a nutritionist and is encountering clients with various types of disorders such as diabetes, heart disease, and high blood pressure. Since each disease will require different food preparation. For each client:
    1. Select which foods from the four basic food groups will aid each client's disorder.
    2. Decide which clients should eat unrestricted salt, low salt, and no salt.
    3. List which clients can eat unrestricted fats, and low fats.
    4. Formulate food portions according to weight and disorder.
    5. Ask a nutritionist to provide any other important information to share with the class.

2. Tracey is a counselor for clients who have eating disorders such as anorexia nervosa and bulimia. Anorexia nervosa is an eating disorder in which afflicted people starve themselves. Bulimia is an eating disorder in which sufferers engage in binge-purge cycles of eating followed by vomiting. Tracey realizes that both disorders primarily afflict young middle-class women, but men may also be victims.

    Students should analyze how counseling these individuals will help them resolve the following: (Discussing various techniques that may be used for each example).
    1. A distorted perception of their body weight.
    2. Overwhelming fear of being fat.
    3. Starving themselves.
    4. Taking laxatives and vomiting to lose weight.

    Students will write to a counselor that works with clients who have eating disorders. A counselor should be invited to speak to the class to share information pertaining to nutrition and eating disorders.

Other Activities

1. Start a discussion with students by asking them what they had for dinner last night. Make a list on the chalk board. Ask the students if this was a nutritious meal. What does that mean? Define it. Provide students with a list of the six nutrients and the basic food groups. Divide students into small groups and have them match which part of the meal contains which nutrients

and determine the food groups which they belong to. In a quiz, students will be asked to list the five nutrients required to maintain good health. They will also be asked to prepare a list of the four food groups and create a table of foods that belong under each food group.

2. Students will be able to list two ways that thee body uses lipids, proteins, carbohydrates, vitamins and minerals. They will share their ideas and expand on these ways in the form of an journal entry. They will share their journal entries with their classmates by reading them aloud to the class.

3. Discuss with the students two diseases that result from nutrient deficiencies. Have them share any personal experiences and those of relatives or friends. Have them chart the similarities and differences of these diseases.

4. Link home economics and science by creating a class cookoff. Have students identify the foods as consumer or a producer, carnivore, herbivore, omnivore, and /or a 1st, 2nd, or 3rd order consumer. Students will be able to cook a well balanced meal selected from the four food groups and placing the foods in the various categories to create a chart.

5. Invite a nutritionist to speak and discuss the importance of nutrition and the diseases that result from the lack of nutrition. The nutritionist can speak on the importance of vitamins and minerals. Show a video and pass out literature concerning nutrition. Homework Assignment: Students will write a diet plan for a person with peptic ulcers using the four food groups, and listing foods that should be avoided.

6. Students will bring in food labels to discuss the nutritional values. They will also review diet plans to determine the balance of their caloric intake and average caloric usage, and forecast the effect that such a diet may have on the human body (such as eating too much fast food, too much sugar, salt, and fat). Students will create a chart with the brand name, type of food, caloric value, and presence of saturated and unsaturated fats in each food. Students will write a balanced diet for an entire week as a homework assignment.

The following Labs are suggested to be used where appropriate:

Lab #1, "How Do We Choose the Foods We Eat?" The purpose of this lab assignment is to compare food items for special diets to those of standard diets. Upon the completion of the lab, students will be able to evaluate how well modified food approximates the smell, appearance, and taste of standard food items. They will also discover which of their senses are most important in judging the acceptability of food. (CORD *Applications in Biology/Chemistry - Nutrition* p. 27)

Lab #2, "What Role Do Our Senses Play in Food Preferences?" Students will conduct food preference tests in this laboratory assignment. When students have completed this laboratory assignment they will be able to rank physical and chemical aspects of food according to their importance in food choice. (CORD *Applications in Biology/Chemistry - Nutrition* p. 33.)

Lab #3, "What Nutrients Do Our Foods Contain?" The purpose of this laboratory assignment is to run assays for nutrients in food. After completing this laboratory assignment students will be able to determine the presence of fat, protein, carbohydrate, and vitamin C in food. They will also compare the amount of vitamin C in different foods. (CORD *Applications in Biology/Chemistry - Nutrition* p. 76.)

Lab #4, "What Factors Affect the Vitamin C Content in Food?" Students will be able to determine the amount of vitamin C in a sample of fruit or vegetable. Upon completion of this laboratory assignment students will be able to perform a common test for determining the amount of vitamin C in foods. They will be able to compare various fruits and vegetables as sources of vitamin C. Also, they will design an experiment to answer a question about vitamin C. (CORD *Applications in Biology/Chemistry - Nutrition* p. 82.)

Optional: Students will be shown a video that will discuss the effects of eating disorders, such as anorexia nervosa and bulimia. This will be followed by a class discussion.

Suggest that students write a letter to a famous athlete of their choice, and ask the athlete about his or her diet. Ask the athlete how this diet enhances his/her performance. Share this informa-tion with the class and discuss whether this information agrees or disagrees with what you have learned in this unit regarding diet.

Invite a physician to visit the class to discuss the excretory system.

The class will be divided in half, and they will play "Family Feud" or "Jeopardy" with vocabulary, completion, true/false, essay, word problems from the unit, and questions from the nutritionist, and the physician who visited the classroom.

Evaluation

20%: Performance in productivity, class and group participation.
25%: Assessment will include observation, verbal responses, written responses, reports, essays, tests, and projects.
35%: All tests will be student ready with the appropriate scoring keys. There will be weekly quizzes provided.
20%: Attendance, behavior, and homework.

Resources

1. Johnson, George B. *Biology: Visualizing Life.* Austin, Texas: Holt, Rinehart & Winston, 1991.
2. McLaren, James E., Lissa Rotundo, and Laine Gurley-Dilger. *Heath Biology.* Lexington, Massachusetts: D. C. Heath, 1991.
3. *Applications in Biology/Chemistry: a Conjectural Approach to Laboratory Science Nutrition.* Waco, Texas: Center for Occupational Research and Development, 1993.
4. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, Indiana, 1994, c 1991.

Unit 7

Human Environmental Awareness

Unit 7: Human Environmental Awareness Suggested Time: 3 Weeks

Introduction

The senses are the source of all the information we humans and other animals receive about our environment. Even when we are asleep, our senses continuously send information to our brains about what is going on around us. By way of our sensory organs, skin, nose, tongue, ears, and eyes, we experience our surroundings, and using our muscles and glands, we respond accordingly.

Through laboratory investigations and activities, this unit will provide opportunities for students to learn how our sensory organs function in making us aware of our surroundings. Also, students will learn how this same knowledge can aid us in the workplace.

Unit Objectives

(Reference numbers refer to the Indiana Biology Competencies)

Students will:

1. Analyze observations and experimentally collected data. (Bio 1.2.3)
2. Select and use reference materials to obtain relevant information. (Bio 1.2.5)
3. Use an electronic database to obtain relevant information. (Bio 1.2.6)
4. Explore careers that require or involve science. (Bio 2.3.1)
5. Recognize that science knowledge and skills are necessary for future success, as occupations change over time and career paths evolve. (Bio 2.3.2)

Workplace Relationships

1. Audiologist - measures, evaluates and rehabilitates human hearing loss; adaptation training for restoring communication skills is administered.
2. Massage Therapist - with scientific knowledge of the human body, uses his/her hands to induce relaxation and increase or decrease blood flow.
3. Independent-Living Rehabilitation Counselor - aids persons with impairments to develop skills for living independently.
4. Optician - dispenses glasses and contact lenses by prescriptions and does fittings for contacts and glasses.
5. Restaurant Chef - uses his/her culinary skills and keen senses of smell and taste to determine the quality of ingredients used in the special cuisines.

Learning Activities / Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

Initial Activities

The purpose of this activity is two fold: to raise awareness of the sense of touch and to give students practice in noting their own responses and recording the responses of another. "Mystery Bags" should be prepared ahead containing several objects that are especially designed to give interesting experiences of touch. Some suggested items are stuffed animals, feathers, cotton balls, glass paper-weights or stones, large gumballs, gummybears, rubber worms, cork or rubber stoppers, soft leather, bottle caps, bits of fabric such as silk, taffeta, satin or netting, kitchen utensils (without sharp edges), small children's toys with definite shapes. To avoid unpleasant practical jokes the teacher will want to check these bags before they are used by the groups.

Have the students select several bags of objects and exchange bags with another group. They should work in pairs, so that one member of the pair supervises the activity and records the responses of the partner in a notebook. (The descriptions should be noted and recorded in terms that are specific.

For example, the glass paperweight might be noted as, "smooth surface, hard, rounded edges, heavy to lift.") The recording should include these observations as spoken by the partner and might also note something such as, "partner drew back at first, then said cold, smooth texture..." Use blindfolds (or if some prefer, closed eyes) while the partner feels the objects and describes the sensations experienced. Students should trade roles with their partner and repeat the exercise.

This activity can be wrapped up with a three-to-five minute discussion of what the students learned from it, which role--subject or recorder--they preferred, and any other observations they have about it. Assign appropriate reading materials from available text resources as homework.

Additional Activities

Motivation: Instruct students to sit very quietly for several minutes. Tell them to pay attention to the kinds of information they are receiving from their senses. Ask students what senses they used and in what ways the information is valuable to them (awareness of surroundings, warning of imminent danger; help in finding food or shelter). Let the students discuss this to further reinforce the importance of our senses.

Now that the students are thinking about the importance of our senses, it's time to put the knowledge to work. Make a chart on the board with the five senses (sight, hearing, touch, smell and taste) as headings. As a class, list on the board as many of the stimuli associated with each of the five senses as you can. Be specific and descriptive. For example, in the case of hearing, do not list only "sound." Instead list specific types of sound such as school bells, music, spoken language, etc. Then have students identify how they make use of each of the stimuli on the list. Of course, this list could go on forever, and that is the point of having students do it-- to increase their awareness of what sensory stimuli are and how they affect us. Divide students into five groups and assign each group one sense organ (appropriate for cooperative learning activity, see below). Let the students discuss the task below and decide which task each group member will perform before giving any assistance. Each group member will choose one of the following tasks:

TASK 1: Draw a labeled diagram of the sense organ and explain it to other group members.
TASK 2: Write a brief summary of how the organ works and explain it to other group members.
TASK 3: Write a brief summary of special information and problems associated with the sense and explain it to other group members.
TASK 4: Assist all other group members and then present a summary of the information to the whole class. Vary the distribution of assignments or group size if the class has more or less than twenty students. (These task have been adapted from *Biology: The Study of Life*, Prentice Hall, and can be modified in any way.)

Cooperative Learning Activity: In this strategy, all group members work together to produce one final product. The product might be a written research report, a laboratory report, an oral or audio presentation, a model, a chart, or a class demonstration.

In this model, there are three ways that groups may function. They may work together as a *Generalized Cooperative Learning Group,* where each member shares equal responsibility for completing all tasks and producing the product; as a *Structured Cooperative Learning Group,* where each member has responsibility for a particular job; or as a *Jigsaw Cooperative Learning Group,* where each member executes a portion of the task.

The teacher may use a variety of evaluation techniques when cooperative learning strategies are employed. For instance, all students can receive the same grade based on the group product, or one student can be selected at random to answer questions for the group about the work done and about the final product; in the latter case, the group grade is based on the answers given by the individual. Alternatively, each person in the group can be tested to assess individual knowledge about the final

product. Here, the final grade can be calculated by averaging the test scores of all group members, or all members may be assigned the lowest score attained by any one member.

View video: "Senses and Behavior" (7 min., 20 sec.)*CORD Animal Life Processes,* subunit 1. Then list the sense organs on the chalkboard. Briefly discuss the kinds of information received by each. Using models or other text resources (transparencies, diagrams in the text, etc.), point out the parts of the eye and the ear. Explain how vision is produced in the eye and how hearing occurs in the ear. When discussing the eye, explain nearsightedness, farsightedness, the blind spot, night blindness, and color blindness. When discussing the ear, include an explanation of how the inner ear affects our sense of balance. Refer students to text diagrams and differentiate the various receptors found in the skin. Discuss their distribution in the body. Identify taste buds and explain their role in the sense of taste. Discuss the role of olfactory cells in the sense of smell and point out their effect on taste. Point out that both taste and smell are chemical senses. Whenever possible have speakers come in and address these topics or plan field trips to occupational areas that involve the sense.

Assign appropriate reading materials as homework. For reinforcement, have students do outside research on job profiles associated with our senses, and present them to the class and/ or bring in several guest speakers .

Computer simulation game: "Exploring the Fascinating Workings of the Human Sense Organs." (Apple II Series)

Lab: "Where Is Our Body Sensitive To Touch?" *CORD Animal Life Processes.*

Activity 1.2 "What does the Sense of Smell Tell Humans and Other Animals?" Research to find studies of scents produced by humans that may or may not affect human sexual behavior.

Video, "Animal Sexual Behavior" suggested from *CORD Animal Life Processes.* Discuss video.

Read and discuss "The Sense of Hearing", PSG. 18-24 from *CORD Animal Life Processes.*

Bring in an audiologist as a speaker and allow question and answer period. Plan a field trip to an audiologist's office to provide students with the opportunity to use real equipment.

Computer Simulation: Identifying human hearing structures and matching them to their functions. Students will quiz themselves using the computer.

Lab 3: "How do People with Hearing Loss use Visual Cues?" *CORD Animal Life Processes.*

Computer Application: "Exploring the Fascinating Workings of the Human Sense Organs (Eyes)".

Discussion: "The Sense of Sight and What Causes Us to Experience Vision". Allow students to brainstorm and make a class chart of ideas. Then divide students into groups of four. Have groups perform Activity 1.3. Using red and white circles with diameters of 4-6 inches, mount them on a piece of blank paper at least 8 inches apart. Stare at the red circle for at least 45 seconds, then quickly focus to the white circle.

Bring a speaker to discuss: The Role of the Brain in Vision.

Student research on nearsightedness and farsightedness. Include the latest lenses and surgeries and report results to the class.

Invite an independent-living rehabilitation counselor and an optician as speakers to discuss their job profiles and descriptions.

Evaluation

25%: Evaluations will be completed using a checklist or rubrics of student performance in group participation, projects and productivity.

25%: Assessment of individual student portfolios. Students will keep a "file" of their work, which will be turned in for teacher's assessment at the end of the unit.

35%: Standard Friday quizzes and tests, with immediate feedback, will reinforce the applications taught.

15%: Student behavior, attendance, class participation, and assigned homework tasks will be evaluated to determine whether student has achieved required learning objectives.

Resources

1. *Applications in Biology/Chemistry*: Teacher's Guide. Waco, Texas: Center for Occupational Research and Development, 1993.
2. McLaren, James E., Lissa Rotundo, and Laine Gurley-Dilger. *Heath Biology*. Lexington, Massachusetts: D. C. Heath, 1991.
3. Tools for Active Teaching and Active Learning, "Senses: The Philosophy of Human Sense Organs." (Apple II Series Computers.)
4. Schraer, William D. and Herbert J. Stoltze. *Biology, the Study of Life*. Englewood Cliffs, New Jersey: Prentice-Hall, 1995.
5. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, Indiana, 1994, c 1991.

Unit 8

Ecology

Unit 8: Ecology — Suggested Time: 3 Weeks

Introduction

Ecology is the study of how organisms interact with their environment. The environment includes abiotic (nonliving) and biotic (living) factors. In this unit, students will learn how they adapt to environmental factors, i.e., climate, temperature, etc., as well as geographic diversities that are unique to particular species of organisms. The role of man and his interaction with the environment will also be explored.

Unit Objectives

(Reference numbers refer to the Indiana Biology Competencies)

Students will:

1. Formulate scientific questions. (Bio 1.1.1)
2. Gather scientific data through research, testing, measurements, and calculation. (Bio 1.1.2, 1.2.1)
3. Construct graphs and data tables. (Bio 1.4.1)
4. Draw conclusions from data gathered. (Bio 1.4.2, 1.4.4)
5. Write a formal laboratory report. (Bio 1.3.1)
6. Incorporate and use scientific terms appropriately in reports. (Bio 1.2.1, 1.1.1)

Workplace Relationships

1. Environmentalists / Conservationists - focus on how to maintain a stable state in the environment by, for example, prevention of the accumulation of fossil fuels in the atmosphere or removal of toxic substances from our lakes and streams.
2. Farmers / Agricultural Researchers - focus on soil quality and fertilization in relation to plant growth.
3. Marine Biologists - study the ecosystem of the ocean.
4. Chemical Technicians - focus on chemical substances in our soil and water, also aid in finding ways to maintain stability of these abiotic factors.
5. Climatologists / Meteorologists - study the effects of natural phenomena such as earthquakes, tornadoes, volcanic eruptions, and global warming.

Learning Activities / Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

Introduction

To introduce this unit to students, a brainstorming session can be used to spark the interest and prepare students to think about the environment and factors which cause change (positive or negative).

Propose an environmental issue to get things started. An alternate approach to brainstorming could be to have students bring in articles from the newspaper which deal with the environment. These articles may be used to initiate class discussion and also to find out if students have an idea of environmental issues and problems.

Activities

1. Plan a field study of a nearby available ecosystem. Divide students into small groups and assign students task to investigate. Task should include investigation of physical factors and population relationships in the biotic community. Select the study site based on your familiarity with, and the potential use of, the area. Be sure to consider safety and transportation as other important factors in your selection.

2. Visit and area undergoing succession, such as a field formerly used for agriculture, or a duneland area, or a pond or water source area with encroaching marginal vegetation. Assign students different task to investigate.

3. Divide students into groups of four and provide each group with pictures of the yard of an abandoned house; an unused field on a farm; or a vacated parking lot in a city. Have students describe what happened. (Most students will identify that the area has become overgrown. The areas were no longer maintained the way they had been, and a natural pattern of change has taken place.) Students should identify the factors necessary for an ecosystem to remain stable. Predict the type of community and the ecological succession that will occur. Have students associate as many ecological terms as possible to these communities.

Laboratory Activity 1: "How Do Some Things Vary?"

Prior to performing the following laboratory exercise, students may be taken outside to collect a variety of leaves from the school grounds. (Or students may bring in a collection of leaves from their neighborhoods.) The students will examine the leaves and list the characteristics of each. While performing the laboratory exercise, the students must focus on answering these two questions:

1. Why do these leaves differ?
2. What is the significance of these differences?

Materials: Masking tape, metric ruler, pen, paper

Procedure:

1. Take strips of masking tape and number enough strips to attach to each leaf.
2. Construct a data table with the following information
   a. Leaf number (#)
   b. Length in millimeters (mm)
   c. Characteristics
3. Examine each leaf, record the identification number, measurements and characteristics of each.
4. From the data gathered, have students answer the questions posed in the introduction.
5. Have students choose one leaf to research. This information will be shared with the class. These presentations can be used as a way of earning extra credit points.

Note: This laboratory experiment may be modified to include other organisms of your choosing.

Suggested Readings:

1. *Community of Life, Cord Applications In Biology/Chemistry*, pp.. 1-13,185-187
2. *Heath Biology* , pp. 801-806
3. *Holt Biology Visualizing Life*, pp. 247-252

Films, Videos, Filmstrips:

1. *What Is Ecology*
2. *Adaptations of Plants*
3. *Carnivorous Plants*

Field Trip Suggestions:

1. Dunes National Lake Shore Environmental Center
2. Deep River
3. Marquette Beach
4. Northwest Indiana Water Treatment Plant

Laboratory Activity 2: "Predator/Prey Relationships"

All organisms require energy to survive. Plants are called producers because of their ability to make their own food. Most organisms must depend on other organisms for food and are classified as consumers.

In this activity, the students will act as predators preying on other organisms for food.

Before starting this lab, obtain ten sheets of construction paper of ten different colors. Using a single hole puncher, punch out dots to be used as prey. Keep all colors separated and stored in separate containers. You will also need a variety of colorful floral fabric pieces, approximately 1 sq. yard each, to represent a forest.

Materials:

1. 100 Colored dots (10 of each color)
2. Colorful material
3. Graphing paper
4. Metric ruler
5. Colored pencils (optional)

Procedure: (Students work in groups of four)

1. Spread cloth on a table.
2. Sort dots making sure there are 10 of each color (100 total). Each color represents the prey species. (The type of species is optional.)
3. Spread dots over the cloth.
4. Each person in the group take turns randomly picking up one dot at a time until 25 have been removed from the cloth. (Count out loud as dots are being removed.)
5. Sort out the dots into separate groups according to color.
6. Count each color and record on the data sheet.
7. After recording the results return the 25 dots to the cloth and repeat steps 4-7 three more times.
8. Average all four trials and record on data sheet.
9. Sort out the dots and return them to their appropriate containers.
10. Construct a bar graph from the averaged data obtained by plotting the number of prey eaten on the X-axis and the type of prey eaten on the Y-axis.

Analysis:

1. Based on the data gathered, which organism survived in the greatest numbers? _____

   Why? _____

   _____

   _____

2. Which organism was eaten in the greatest number? Why? _____

   _____

   _____

3. Define the following terms:

   A. Camouflage _____

   _____

   B. Mimicry _____

   _____

   C. Omnivore _____

   _____

   D. Carnivore _____

   _____

   E. Herbivore _____

   _____

   F. Scavenger _____

   _____

   G. Decomposer _____

   _____

   H. Food Web _____

   _____

   I. Food Chain _____

   _____

Cooperative Learning Evaluation

	Excellent	Good	Fair	Poor
1. Groups worked cooperatively				
2. Group roles were carried out				
3. Materials put away/area clean				

10

Laboratory Activity 3: "How Organisms Adapt to Cold"

Organisms adapt in order to survive. One adaptation is the ability to survive in various areas with diverse climate. How is it possible for desert plants to survive in an area where there is very little rainfall? Why are some animals found in a particular area whereas other organisms can be found in more than one area? These questions and more will be answered in the following activities.

Materials:

1. Three containers with lids, 8 oz. yogert cartons may be used or 250 ml. containers
2. Three containers with lids, 24 oz. cottage cheese cartons or containers which can hold 750-1000 ml
3. Three Celsius thermometers
4. 100 ml graduated cylinder
5. Foam rubber, 2.5 cm thick and approximately 21 cm x 28 cm
6. Scissors
7. Masking tape
8. Clothing (winter) such as socks, scarves, gloves
9. Graph paper (two sheets)
10. Clay or paraffin
11. Three colored pencils
12. Hot water
13. Sand or soil
14. Organic (natural) materials: leaves, paper, grass, wood chips

Procedure: Part I (Students work in groups of three)

1. Number the 250 ml containers 1, 2, and 3. Each cup represents an animal
2. Add equal amounts of hot water to each container.
3. Punch a hole in each lid with the scissors and insert the thermometer through the hole in each lid. Clay or paraffin can be placed securely around the top opening of the lid to prevent heat loss.
4. Enclose container #1 in the foam and secure it with masking tape.
5. Wrap container #2 in one of the objects of winter clothing.
6. Leave container #3 as it is.
7. Record temperatures on data table every 5 minutes to 15 minutes.

ANIMAL	Temperature after 5 minutes	10 minutes	15 minutes
# 1 FOAM			
#2 WINTER CLOTHING			
#3 NO COVERING			

8. Plot the data on graph paper. The x-axis represents animal body temperature (c) and the y-axis , time (min.). Use different colored pencils for each animal.
9. Clean containers and use in Part II.

Part II

1. Place the 3 small 250 ml. containers inside the larger (750-1000 ml) containers.
2. Label these larger containers X, Y, and Z.
3. Leave container X as is. Insulate container Y by adding sand or soil to the large container so that it surrounds the smaller cup. Container Z is surrounded by the organic material.
4. Add equal amounts of hot water to each 250 ml. container and close, with the lid and thermometer attached.
5. Record the temperature every 5 minutes for 15 minutes.
6. Plot the recorded data from table 2 using a different color to represent different animals. Use procedure in Part I, Step 8.
7. Title each graph to identify the type of data being plotted.
8. Write a formal laboratory report.

Suggested Readings

1. *Community of Life, Cord Applications in Biology/ Chemistry*, pp. 96-113, 162-178
2. *Heath Biology*, Chapter 47, pp. 782-796
3. *Holt Biology Visualizing Life*, pp. 257-260

Laboratory Activity 4: "Is it Biodegradable or Nonbiodegradable?"

Our ecosystem is always changing. Environmental changes, whether naturally occurring or from human intervention, can cause physical as well as biological changes. Some of these disturbances will be explored.

NOTE: This activity may be done at the beginning of the school year and completed at the end.

1. Explain the terms biodegradable and nonbiodegradable and their significance.
2. Have students bring objects from home. Students should work in groups of four.
3. Sort objects based on whether they are biodegradable or nonbiodegradable. (Students decide.)
4. On poster board, students will list their items based on the ability to decompose.
5. Choose two areas on the school grounds to bury these objects. At the end of the school year, students will dig up objects and compare the results to their charts.
6. For wrong guesses, have students try to determine why they were incorrect.
7. Discuss the importance of recycling and what effect waste can have on our environment.

Assessment

1. Vocabulary quizzes can be given weekly.
2. Through presentations, students will explain what they have learned. They may use any projects or assignments, demonstrations, posters, etc.. The assessment can be presented in groups, however, a group and individual grade should be given. Individual projects will be assessed as each activity is completed. Unit assessment should be based on all of the above.

Resources

1. *Applications in Biology/Chemistry*: *a Conjectural Approach to Laboratory Science. Continuity of Life.* Waco, TX: Center for Occupational Research and Development, 1993.
2. McLaren, James E., Lissa Rotundo, and Laine Gurley-Dilger. *Heath Biology.* Lexington, MA: D. C. Heath, 1991.
3. Johnson, George B. *Biology: Visualizing Life.* Austin, TX: Holt, Rinehart & Winston, 1991.
4. Miller, Kenneth R. and Joseph Levine. *Biology.* Laboratory Manual. Englewood Cliffs, NJ: Prentice Hall, 1991
5. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, IN, 1994, c 1991.

Unit 9

Natural Resources

Unit 9: Natural Resources — Suggested time: 3 weeks

Introduction

This unit provides an overview of natural resources and how our survival depends on air, water, soil, fuels, plants, and animals. The unit defines natural resources, gives examples, and discusses four major uses for natural resources. It defines the terms - limited, unlimited, renewable, and nonrenewable - and gives examples of resources in each of these classifications. The main focus is on water. The unit will also feature occupations in which people take an active part in protecting and using natural resources.

Unit Objectives

(Reference numbers refer to the Indiana Biology Competencies)

Students will:

1. Develop skills in using common laboratory and field equipment and perform common laboratory techniques using natural resources with care and safety. (Bio. 1.2.4, 1.2.5, 1.2.6, 1.2.7)
2. Use the processes of scientific inquiry to analyze natural resource issues in the natural world. (Bio. 2.2.3, 2.3.2, 2.1.1, 2.1.2)
3. Recognize how the physical or chemical environment may influence how different resources affect one another and affect us. (Bio. 3.4.4, 1.1.1, 1.1.2, 1.2.1 1.5.1)
4. Recognize natural resources as limited resources, unlimited resources, renewable resources, and nonrenewable resources. (Bio. 3.4.5, 3.5.1, 3.5.2)
5. Explore careers that involve science in relationship to natural resources. (Bio. 2.3.1)

Workplace Relationships

1. Environmental and Chemical Analysis Technicians - primary responsibility is for air or water quality; check air quality equipment and monitoring instruments; oversee water quality and supervise the disposal of bottom ash to prevent contamination of ground and ground water.
2. Power Plant Operators - may operate fuel- and ash-handling systems; operate major support equipment; work as control room operators.
3. Gas Analysis Technicians - usually work for energy companies of power plants; they may work both in the field and in the laboratory. Both field and laboratory technicians require high school diplomas. The lab technician should have some college chemistry. A two-year degree in chemistry is ideal for both positions.
4. Air Pollution Control Technicians - may be field technicians who install, operate and sometimes repair air sampling equipment; take air samples that are analyzed to find out if harmful gases or particles are in the air. Requires a two-year degree in chemistry and/or another year of courses in instrumentation at a technical school.
5. Municipal Wastewater Treatment Technicians - conduct lab tests; report on quality to the federal Environmental Protection Agency (EPA); take samples of effluent (water that is going out of the plant after treatment) and test it; run tests to find out what suspended solid matter is in water; monitor the growth of microscopic organisms.
6. Soil Conservation Technicians - provide technical advice and assistance to farmers, ranchers and other landowners to help them prevent soil erosion.
7. Veterinarian Technicians - requires a two-year college training program and additional on-the-job training. They assist veterinarians with animal care and surgery.
8. Water Treatment Technicians, Aquatic Biologists - collect samples from natural water bodies, industrial wastes, or other water sources.
9. Other Jobs include: Nutritional consultant, nutritionist; biologist and wildlife managers; miners, farmers, and fishers; auto manufactory workers; food processing workers; conservationists.

Learning Activities / Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

Week One

Day One: "What's in an eight ounce glass?"

Collect water samples from several sources such as rainwater, well water, city water, pond water, stream water, lake water, and wastewater at different stages of treatment. Have students visually compare the samples. Then compare the odors of each sample. Ask students which sample(s) they would drink. Finally have students write a description of each sample and measure the pH .

Lead the students in a discussion about these water samples and the locations from which these sources were collected. List several items that may be found in each of these water samples on the board in a chart form (microorganisms, pollutants, chemicals). Ask students to suggest tests that could be done to determine if their samples would be safe to drink. List jobs that would be connected to testing these types of water samples.

Day Two: Introduce water problems / Field trip to natural water body
Note: Students will need time allocated during the three weeks for their project.

Some people think that you should not drink the water in Lake Michigan. How would your life be different if this were true? Research the quality of water found in Lake Michigan. Consider each of the four factors affecting water quality:

- suspended matter
- dissolved substances
- pH
- temperature

Optional: Have students research and report on PCBs and other toxins that affect organisms.

Take a field trip to Lake Michigan or a nearby body of water. Use a water test kit to test samples from the water source for nitrates, phosphates, and pH. Use the results of the tests to predict problems that might occur. Discuss measures that can be taken to correct the problems.

Have environmental changes caused changes in the Lake Michigan water source?
Have these environmental changes caused any occupations to disappear?
Have these environmental changes caused changes in any occupation?
Have these environmental changes created any new occupations in the Lake Michigan area?

Before students begin their water problem projects, they must write a plan and have the teacher approve it. The plans must include topic questions that the students want to answer, possible resources, and how they will show what they've learned when they've completed their group project.

These projects will use structured cooperative learning groups where each member has a responsibility for a particular job or task to perform.

Define the task. Tell the students that they will:

- Work cooperatively in a group of four to complete the water problem. Field trip to natural water body.

- Decide which member will be the group manager (responsible for assigning tasks, monitoring progress, and seeking solutions to group problems); which will be the group recorder, (responsible for keeping track of all written materials and writing out the final laboratory report); which will be the group runner, (responsible for gathering materials, collecting samples, and cleaning and returning materials); and which will be the group reporter (responsible for summarizing and reporting group observations and conclusions to the class).
- Follow procedures described in the water problem as directed by the manager and answer all questions.
- Create one final written laboratory report prepared by the group and written by the group recorder.
- Create one poster-sized chart that explains the relationship of the four factors affecting water quality (suspended matter, dissolved substance, pH and temperature).

Day Three: Students will work in their groups to plan, write and get teacher's approval for their projects. Stress that they will have to do outside research as a group.

Day Four: Lab - "How Is A Resource Depleted?"
Suggestion for this lab: Use CORD, Natural Resources, Unit 1, pp. TN-22 through TN-26. Be sure the lab groups vote on the best method (see list of techniques, p. 24 in student text) for their simulated mine.

Day Five: View and discuss the video, " An Introduction to Natural Resources." (9 minutes, 37 seconds). See About the Video, pp. T-12 to T-13 in CORD *Natural Resources* manual.

1. Have students take notes
2. Discussion questions and a summary of the video in " About the Video" on page T-12.
3. Use the "Think About It" activity to lead the students in a discussion. Answer the questions provided on p. 2 in the Cord, Natural Resources, Subunit 1.
4. List several items on the board (computer, CD player, stereo system, car, tennis shoe, loaf of bread, desk) is a chart form.
   a. Ask students to name raw materials they would need if they wanted to make these items from scratch.
   b. Ask students which raw materials they believe might some day run out and which probably will not.
5. Assign resource reading material as homework. Suggested reading CORD *Natural Resources*, subunit 1, pp. 1-20.
6. Reflect, Review, Reinforce, Quiz

Week Two

Day One: It's All In A Bag of Trash (This activity has been revised from the Trash Activity taken from CORD, Natural Resources Unit)

1. Hold up a trash bag filled with objects which could be recycled: Plastic two liter soda bottle, plastic milk jug, aluminum can, cereal box, cookie bag, glass jars (pickles, jelly, jam, juice), shoe, tissue, chip package, etc. Remove the contents of the bag and place the items on the counter top. Lead the students in a discussion on the origin of each item. Then ask them if these items can be recycled. Introduce the terms limited, unlimited, renewable, and nonrenewable. Allow students to define these terms in their own words. As a class, divide the items above into four categories: limited/renewable, limited/nonrenewable, unlimited/ renewable, and unlimited/nonrenewable. Continue discussion by asking students if they have a recycling program in their community, neighborhood, or school. Now that the students have some concept of what natural resources might be found in a bag of trash, divide the class into five groups.

2. Each group should be given a bag of trash from the teacher. The bag will have items such as the list in #1. Be sure each bag has some similar and some different items. Also get a card that says renewable, nonrenewable, limited or unlimited The group should go through the bag of trash considering the following questions.
    a. Which items are limited and renewable?
    b. Which items are limited and nonrenewable?
    c. Which items are unlimited and renewable?
    d. Which items are unlimited and nonrenewable?

   Have students individually construct a Table of Data for the contents of their trash bag, using the four categories. Have them compare their tables as a group for differences of opinion on how some items should be classified and to reach a consensus. Then as a class construct a master Table of Data and answer the following questions.
    1. What natural resources are found in the bags of trash?
    2. Describe which resources in the trash are available forever. Which resources are in danger of running out?
    3. Could any of these trash items be recycled? How does recycling help the supply of natural resources?
    4. What problems are created when trash is discarded? Which items will easily break down? Which won't?
    5. List some jobs associated with the creation, use, and disposal of this bag of trash.
    6. What can you and your family do to help preserve natural resources through proper trash disposal?

Day Two:
1. Reflect, Review, Reinforce (check for understanding and use of terms)
2. Quiz oral or written, Grade and Discuss answers.
3. Homework-Assign reading materials that cover natural resource terms and examples. Have students take notes and list examples in their notebooks. Suggested reading Cords, Natural Resources, Subunit 1 or other related reading materials in textbook available.

Day Three:
1. Bring in a speaker from a natural resource related job. (Optional) Provide question and answer time. Or Set up a display with samples of natural resources: pictures, portable oxygen tank, water, fossil fuel, soil, plants and animals. Have students observe, compare, suggest how these things are related and why they are important to them.
2. Have students answer the Study Questions for Subunit 1, Introduction to Natural Resources, Cords, pp. M1-E or questions provided by your text.

Day Four:
Review, Reflect, Connect, and Test

Day Five:
Time provided for students to work on water problem project

Week Three

Day One:
Reflect, Review, Connect and Reinforce.

Day Two:
Continue the water problem project allowing students to work together in their groups to complete their project.

Day Three:
Begin water problem project presentations.

Day Four:
Continue water problem project presentations.

Day Five:
Finalize water problem project presentations and have students make a class chart of their results. Discuss, reflect, review, and connect.

Optional Activities (These activities are intended to supplement your own materials for this unit. Some of these have been adapted from the CORD, *Natural Resources* unit.)

1. Ask students to investigate recycling programs in their community.
   a. Have the students find out what kinds of materials are accepted for recycling.
   b. Have them give locations of collection points and days on which collections are made.

   Have students read a short magazine article about natural resources that includes controversial information.
   a. Have students write brief responses.
      - Briefly tell what the article is about.
      - What is their opinion?
      - Give two reasons this article is important to read.
   b. Discuss.
2. Cooperative group activity
   a. Group size: 3-5 students.
   b. Outcome: Students will be able to create a game or puzzle associated with natural resource terms that will teach them and their classmates the definitions or usages.
   c. Individual accountability: Each group member will be responsible for completing part of the research needed to create the game or puzzle.
   d. Positive interdependence: Groups will name and construct the game or puzzle.

   Have each group member:
      - Select a position (leader, recorder, timer, messenger).
      - Select ____ number of terms.
      - Define the terms selected.
      - Make up _____ number of rules.
      - Construct and assemble game or puzzle.
      - Participate in oral presentation to the class (explain and play game)
3. Have students pick a job that interests them from the list of jobs that are connected to natural resources. (Teacher provides list)
   a. Have them write a brief description of their chosen job. Include skills needed and tasks performed by people who hold the job.
   b. Then have them explain how this job relates to natural resources.
   c. Interview someone whose job is directly related to natural resources.
4. Have students make a list of at least ten (10) things they would use if they were on another planet just like Earth, except that it has no people.
   a. Have them compare their list with lists made by other students. Students should add things they overlooked.

b. Students should classify each natural resource on their lists in two different ways
   - renewable or nonrenewable resources
   - limited or unlimited resources

c. Have students make a table from these lists.
   - renewable / nonrenewable resources
   - limited / unlimited resources

d. Compare their table with those of other students and discuss the differences.

5. Give students a descriptive paragraph with location for a job site, the students' occupation and their responsibility for restoring the site to a usable state after it has been mined.
   a. Tell students, based on the information given, to decide which mining method they would recommend for the site described. Why?
   b. Have students answer questions:
      - How do you think this operation will affect natural resources in that area?
      - How will this effect on natural resources affect you personally (i.e. jobs, health, transportation, etc.) ?

Evaluation

25%: Evaluation will be completed using a checklist of student performance in group participation and productivity.

20%: Assessment of individual student portfolios. Students will keep a notebook of their work, which will be turned in for teacher's assessment at the end of the unit.

35%: Standard quizzes and tests, with immediate feedback, will reinforce the applications which were taught.

20%: Student behavior, attendance, class participation, and assigned homework tasks will be evaluated to determine whether student has achieved required learning objectives.

Resources

1. McLaren, James E., Lissa Rotundo, and Laine Gurley-Dilger. *Heath Biology.* Lexington, Massachusetts: D. C. Heath, 1991.
2. Johnson, George B. *Biology: Visualizing Life.* Austin, Texas: Holt, Rinehart & Winston, 1991.
3. *Biology Today* Text and resource materials. Austin, Texas: Holt, Rinehart and Winston, 1990.
4. *Applications in Biology/Chemistry: a Conjectural Approach to Laboratory Science. Natural Resources* Waco, Texas: Center for Occupational Research and Development, 1994, c 1990.
5. Schraer, William D. and Herbert J. Stoltze. *Biology, the Study of Life.* Englewood Cliffs, New Jersey: Prentice-Hall, 1995.
6. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, Indiana, 1994, c 1991.

Unit 10

Water

Unit 10: Water — Part I: How Does Water Support Life?

Introduction

Part I of this unit explores the following questions:

- How does water support life?
- What is the role of water in regulating temperatures?
- What is the role of water in transporting nutrients and other materials?
- What is the role of water in biochemical reactions?
- How do organisms maintain water balance?

This section of this unit is intended to provide experiences for students that will allow them to evaluate the effect of different water uses on water quality and water quantity and analyze the role of water in maintaining life.

Section Objectives

(Reference numbers refer to the Indiana Biology Competencies)

Students will:

1. Explore careers that require or involve knowledge of how water supports life. (Bio 2.3.1)
2. Describe how organisms are influenced by a particular combination of living and non-living components of the environment. (Bio 3.2.1)
3. Recognize how the physical or chemical environment may influence the rate, extent, and nature of development of organisms that depend upon these aspects of environment. (Bio 3.4.4)
4. Describe how stability is challenged by changing physical and chemical environmental conditions as they relate to the water cycle. (Bio 3.6.2)

Workplace Relationships.

1. Hemodialysis Technicians - work in a clinic that treats patients for chronic kidney failure, responsible for hooking the patients up to the dialysis machine, monitoring their status, and disconnecting them from the machine when they are finished. Patients must be weighed, have temperature and blood pressure checked. Technicians must be capable of checking machinery.
2. Phlebotamists - work in a variety of setting to include hospitals, clinics, private offices medical or dental offices. They are responsible for taking patient's blood.
3. Pet Store or Aquatic Animals Technicians - must maintain water balance for aquatic animals.
4. Sports trainers - concerned with rehydrating the body.
5. Landscape Gardener/Architects - need to understand the effects of soil types
6. Breeders - concerned with the cost effectiveness of raising animals for food in arid regions.
7. Nurses - need to understand fever as an indicator of illness.
8. Quality Assurance Technicians/Consumer Products Technicians - must maintain the quality of bottled waters.
9. Water Purification Technicians/Supervisors - need to understand reverse osmosis.

Real Life Situations

1. Students are to fill a laboratory sink with water. Add to the sink a small amount of dye. Students are to observe the dye in the water. Ask them what happens to it. Why do they think it behaves the way that it does?
2. Students are to grow or obtain two small bean plants, putting each one in a separate container. Have them label the containers A and B. For a period of several days, have them water plant A with distilled water, and water plant B with a mild salt solution. Students should observe what happens to the two plants. They should hypothesize about the reasons for the growth patterns of the plants, based on what they have learned about water movement in plants.

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Learning Activities / Teaching Strategies

1. Video, "The Chemical Nature of Water: Aquarium."
2. Scenarios, Job profiles.
3. Lab activities.
4. Cooperative learning.
5. Demonstrations.
6. Peer tutoring.
7. Research projects.
8. Visiting speakers.

Resources

1. *Applications in Biology/Chemistry: a Conjectural Approach to Laboratory Science. Water.* Waco, Texas: Center for Occupational Research and Development, 1993.
2. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, Indiana, 1994, c 1991.

Unit 10: Water PART II: How Can We Protect the Quality of Water?

Introduction

This section of the unit is intended to provide experiences for students that will allow them to understand tests that determine water quality, including pH, biochemical oxygen demand, total solids, and concentrations of various solutes in water; link water-treatment methods to different types of wastewater contamination which that treatment is intended to address; suggest several different methods to prevent water pollution during personal or domestic use of water and handling of wastes.

This unit explores the following questions:

- How does pollution enter the water cycle?
- What are the kinds of pollution?
- What processes cause water to become polluted?
- What are the sources of pollution?
- How can water pollution be prevented?
- How is water quality tested?
- How is water treated?

Section Objectives

(Reference numbers refer to the Indiana Biology Competencies)

Students will:

1. Describe how organisms are influenced by a particular combination of living and non-living components of the environment. (Bio 3.2.1)
2. Recognize how the physical or chemical environment (e.g. water quality) may influence the rate, extent, and nature of development of organisms that depend upon these aspects of environment. (Bio 3.4.4)
3. Describe how stability is challenged by changing physical and chemical environmental conditions as they relate to the water cycle. (Bio 3.6.2)

Workplace Relationships

1. Hydrographic Survey Technicians - gather data relative to water quality and movement of natural bodies of water, using surveying instruments such as a sextant, depth recorders, wire drags and navigational instruments, read navigational charts and work with maps.
2. Hydrogeologists - incorporate a basic understanding of groundwater flow with a knowledge of geology and chemistry; for example, might be asked to evaluate groundwater if a company's underground storage tanks were suspected of leakage, or routinely monitor the groundwater in the storage tank area.
3. Wastewater Treatment Technicians - work in the water-quality lab at the waste-treatment plant, determine biochemical oxygen demand of samples of wastewater.
4. Swimming Pool Maintenance Technicians - usually operate own business; insure pool water is chemically balanced by testing alkalinity and adjusting it with chlorine.
5. Environmental Technicians - may work at an electric power plant; responsible for monitoring and testing the water used by the plants systems for cooling.

Real Life Situations

1. Assume that the students are part of a package-design team working for the manufacturer of a potentially harmful insecticide spray. The students are to design a product label that will help users of the insecticide to keep from contaminating water supplies.
2. Students are to contact a solid waste department manager and find out what features of a landfill help to protect against groundwater contamination.

Learning Activities / Teaching Strategies

(These activities are intended to supplement your own materials for this unit.)

1. Visit a landfill or have a solid waste department manager speak to the class. Students should find out how solid waste is disposed of; what kinds of waste are allowed or disallowed in the local landfills; whether there are special provisions for disposal of hazardous chemicals by domestic and business users. Discuss and review findings. Have students write a one page essay on the possibilities of ground water contamination from a landfill. Read and discuss in class. (3 class periods)
2. Show the video, *Is This Water Ok?: Water Filtration Plant.* Discuss the problem: "Why is it a bad idea to pour old paint, varnish and used car oil down the drain?" Complete Subunit 5 Think About It, p. 154, using transparency master, seek answers to questions. Read pages 157-159. Have students write real examples of evaporation, condensation and precipitation, runoff and percolation. Read page 180. Do steps 1 though 4 Lab Activity 5-8, Test for Biochemical Demand(BOD), p. 183.
3. Visit a wastewater treatment plant and a sewage plant and determine the process by which the water is treated, the water-quality tests that are run, and the standards for each test. Have students prepare a diagram or flowchart for each of the treatment processes. They should indicate on their diagrams where water samples are taken and the acceptable range for the results for each test. Compare the two processes and prepare a brief report summarizing your findings. (4 class periods)
4. Read page 182 and pages 193-194. Complete Lab Activity 5-8, Test for Biochemical Demand(BOD), p. 183 and do Lab Activities Part I and Part II, "Testing a Drinking-Water Supply" and "Testing Water from Swimming Pools", beginning on p. 194. (2 class periods)
5. Do Lab Activity 5-9, "Charcoal Filtration" p. 186. Read pages 184-186 and discuss.
6. Read pages 178-181 and discuss. Use a pH meter to test samples of water and other solutions.
7. Read pages 160-164 and discuss. Answer *Real Life Situation #2.* (1 class period)
8. Do Activity 5-3, "Pesticide Assessment", p. 169. Read pages 165-169 and discuss.

9. Do Activity 5-5, "Package Design Team", p. 175. Read pages 170-175 and discuss. Have students do *Real Life Situation # 1* in groups.
10. Do Activity 5-6, "Water Bill Assessment" , p. 178. Read pages 175-178 and discuss.

Assessment:

Lesson 1. Landfill inquiry: See Rubric which follows entitled, "Landfill Assessment."

Lesson 2. Upon reading the assignment, viewing the video, and participating in classroom discussion students should be able to write examples of evaporation, condensation, precipitation, runoff, and percolation.

Lesson 3. Field trip: See Rubric which follows entitled, "Field Trip"

Lesson 4. Lab Activity 5-8, "Test for Biochemical Demand," p. 183.
The expected result is that the level of dissolved oxygen in bottle A after five days will be substantially less than the earlier reading in bottle B. Lab activity "Testing Water Quality": Upon completion of the lab activity students should answer the questions in the Conclusion and Challenge sections on p. 196. Five points may be assessed for each question in that section.

Lesson 5. Lab activity 5-9, p. 186," Charcoal Filtration." Students answer the following questions.

Is time a factor in filtering with charcoal? If so, how?
Is the surface area of charcoal a factor? If so, how?

Students should find that a critical factor in charcoal filtering is the time that the contaminated flow is in contact with the charcoal (detention time), and the total surface area provided for absorption.

Lesson 6. You may want to have students prepare a buffer of known pH to calibrate pH meters. Do have them calibrate the meters whether they prepare a standard or you have one already prepared or some other means of calibration. Students should be able to correctly calibrate and read the pH of at least three solutions, ranging in pH from acidic to basic. See Rubric which follows entitled, "Using a pH meter."

Lesson 7. Students should be able to answer what features the solid landfill has incorporated to help protect against groundwater contamination based on the visit to the landfill or the representative's talk in the classroom. If not, have them contact the appropriate person at the landfill and get the information.

Lesson 8. As students discuss in class the results of the survey, have them decide which groups tend to be most careful with their use of agrochemicals, which is most knowledgeable about potential pollution, and which tend to be the least careful.

Lesson 9. In designing the product label students should refer to the guidelines given in the text.

Lesson 10. In suggesting ways to reduce household water bills, students may receive five points for ideas related to the following usage areas:

- kitchen
- bathroom
- laundry room
- outside

Quiz Questions:

1. Analyze the relationship between water quality and water quantity. (ans.) Numbers 2 and 3, Key to Study Questions, page TN5-14, and Number 2, Key to Subunit Test, page TN5-17, Teacher's Guide.
2. Appraise the methods that are used to treat water to address different types of water-pollution problems. (ans.) Numbers 9 and 10, key to Study Questions, page TN5-16, and Numbers 11, 12, 13, and 14, pages TN5-19 & 20, Teacher's Guide.
3. Predict the potential impact on the quality of surface and/or groundwaters of at least seven different types of water pollution. (ans.) Number 4, Key to Study Questions, page TN5-14, and Number 3, Key to Subunit Test, page TN5-17, Teacher's Guide.
4. Identify the sources of water pollution. (ans.) Number 6, Key to Study Questions, page TN5-15, Teacher's Guide.
5. Distinguish between point-source and nonpoint-source pollution. (ans.) Number 5, Key to Study Questions, page TN5-15, and Number 5, Key to Subunit Test, page TN5-18, Teacher's Guide.
6. Investigate five ways that pollution can be prevented or reduced. (ans.) Numbers 7 and 8, Key to Study Questions, page TN5-15, and Numbers 7, 9, and 10, Key to Subunit Test, pages TN5-18 & 19, Teacher's Guide.

Portfolio:

Student portfolios should include examples of the following:

1. Essay or written report.
2. Appendix 2, teacher-scored rubric from field trip. (Waste and sewage treatment plants)
3. Lab write up. (Any lab activity)
4. Scored rubric for "using the pH meter" (LA6).
5. Label design for insecticide (Real life situation #1).
6. Exam.

Resources

1. *Applications in Biology/Chemistry*: *a Conjectural Approach to Laboratory Science. Water.* Waco, Texas: Center for Occupational Research and Development, 1993.
2. *Indiana High School Science Competencies,* Indiana Department of Education: Indianapolis, Indiana, 1994, c 1991.

LANDFILL ASSESSMENT

GROUP NAME AND NUMBER _____

	Well done	OK	Poor	Not done
1. How is solid waste disposed of?				
2. What kind of waste are allowed or disallowed?				
3. Are there special provisions for disposal of hazardous chemicals by domestic and business users?				

ESSAY:

Based on observation and discussion write a one page essay on the possibilities of ground water contamination from a landfill. Relate the questions above to the following concepts:

	Well done	OK	Poor	Not done
• Runoff				
• Percolation				
• Leaching				

Well Done = 3 pts, OK = 2 pts, Poor = 1 pt, Not Done = 0 pts.

SCORE _____ **(SCALE: 16-18 = A, 13-15 = B, 9-12 = C, 5-8 = D).**

FIELD TRIP
WASTE TREATMENT & SEWAGE TREATMENT

GROUP NAME AND NUMBER_____

WASTE TREATMENT

Determine the following:	Well done	OK	Poor	Not done
1. The process by which the water is treated.				
2. The water-quality tests run on the water.				
3. The standards for each test.				

SEWAGE TREATMENT

	Well done	OK	Poor	Not done
1. The process by which the water is treated.				
2. The water-quality tests run on the water.				
3. The standards for each test.				

FLOW CHART

Indicate on diagrams:	Well done	OK	Poor	Not done
1. Where water samples are taken.				
2. The acceptance range for results.				

COMPARISON REPORT

	Well done	OK	Poor	Not done
1. One page report summarizing similarities and differences.				

Well Done = 3 pts, OK = 2 pts, Poor = 1 pt, Not Done = 0 pts.

SCORE _____ **(SCALE: 24-27 = A, 19-23 = B, 14-18 = C, 8-13 = D).**

USING A pH METER

GROUP NAME AND NUMBER _____

1. Calibration.

Well done	OK	Poor	Not done

pH Readings

	#1	#2	#3
pH			

	Answers
2. Which reading reflects the pH of an acid?	
3. Which reading reflects the pH of a base?	
4. Which reading is probably water?	

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